Hydrological Summary for the United Kingdom

July 2015

General

July was an unsettled month and one of notable contrasts. Though temperatures cooled decisively thereafter, record-breaking heatwave conditions characterised the 1st of the month. Following overnight temperature minima which exceeded 20°C in the south-east, Heathrow recorded 36.7°C, the warmest July day on record for the UK (in a series from 1853) and the hottest day in the UK since 2003. Throughout July, the north of the UK was generally wet and cool, whilst in southern areas conditions were predominantly dry although interspersed with intense downpours and thunderstorm activity. Rainfall for July for the UK was more than 150% of the long-term average and large areas of Scotland and East Anglia received more than twice the average July rainfall. Intense downpours over short durations led to surface water flooding in Hertfordshire, Cambridgeshire and eastern Scotland. Average river flows for July were above normal for most rivers in Scotland and Northern Ireland, notably so in a band from south-west to north-east Scotland. Further south, river flows for some catchments in southern, central and eastern England were below normal, but generally were in the normal range elsewhere. Soil moisture deficits decreased in July across almost the whole of the UK. Despite this, groundwater levels generally fell, a normal occurrence even during moderately wet summer months. Levels remained in the normal range or below across most of England and Wales. Reservoir stocks for England and Wales remained near average for the time of year, though stocks were considerably above average for Scotland (following some large July increases) and Northern Ireland. The commencement of aquifer recharge will be sensitive to the rainfall received over the next few months, but the water resources situation remains healthy approaching the autumn.

Rainfall

A humid air flow from the continent resulted in very high temperatures on the 1st, but thereafter Atlantic frontal systems from the south-west brought unsettled conditions to most parts of the UK. On the 7th, Aberdeen recorded 38mm in a few hours (more than half of the monthly average rainfall) which triggered flash flooding that affected the road network and airport. Overnight on the 16th/17th, intense thunderstorm activity occurred from London to the Wash; Cambridge Botanic Garden registered 87.1mm (mostly in a few hours), more than 150% of the average for July, and Rothamsted (Hertfordshire) recorded 38.2mm in one hour. Roads were closed due to flash flooding and electricity supply was disrupted. On the 17th, intense rainfall in eastern Scotland caused surface water flooding, travel delays and landslides. Persistent rain fell across southern England on the 24th with 20-40mm widely reported, and Suffolk recorded 71mm across the 24th-26th, relative to an average value for July of 45mm. For July overall, the majority of UK regions registered in excess of 150% of the long-term average rainfall, with the Forth region of Scotland exceeding 230% of the monthly average. Parts of north-east and south-west England, and particularly much of Scotland and East Anglia, recorded more than 200% of average rainfall, whilst near or below average rainfall was restricted to areas of Kent and Sussex, the Midlands and the far north of Scotland. Over the last three months, above average rainfall was registered throughout northern and western areas of the UK. Western Scotland registered the wettest May-July in a series from 1910.

River flows

Whilst persistent or heavy rainfall in July did generate seasonally high river flows, fluvial flooding was relatively localised and limited to smaller streams in Scotland which flooded a handful of properties. The exception to this was on the 17th in Alyth (Perthshire), when a surge of floodwater overtopped the Alyth Burn, carrying cars along adjacent roads. A bridge carrying power cables was washed away, disrupting the supply of electricity to 750 properties, and around 100 properties were evacuated. On the 17th, new July daily flow maxima were recorded on the Earn and Tay, with the latter exceeding the previous record by a wide margin in a series from 1952. The Scottish Dee and Bervie also recorded flows on the 17th that were amongst the largest on record for July. For July overall, flows exceeded twice the monthly average for the Forth and Nith, and the Tay recorded its highest average July flow on record. Below normal flows were registered in a band through Wessex, the Midlands and Lincolnshire, with flows generally within the normal range elsewhere in England and Wales. Over the last three months, average river flows generally were above normal across northern and western areas of the UK, notably so across much of Scotland. Exceptionally high average flows were registered for catchments draining parts of northern Scotland; new maximum May to July average flows were established for the Ness (in a series from 1972) and the Nevis (in a series from 1982). Conversely, below normal flows characterised parts of southern and eastern England, notably so in Wessex and the headwaters of the Thames.

Groundwater

Soil moisture deficits decreased throughout the UK in July, but despite this, levels continued to fall at all index sites except Killyglen, Pant y Lladron and Dial Farm. However, in some places recession rates slowed due to heavy rainfall in the last week of the month. With the exception of the fast responding Chalk at Killyglen, levels in the Chalk were near average or below, with notably low levels which persisted since the end of June at Tilshead and Dalton Holme. Levels decreased in July at Chilgrove House and Compton House and were notably low by month-end. In the Jurassic limestones, levels fell and remained in the normal range or below, and in the Magnesian Limestone, levels remained in the normal range at Brick House Farm. In the Permo-Triassic sandstones, levels were near to above average, except for Llanfair DC where levels were below normal. For the second consecutive month, Newbridge recorded a new monthly maximum level. Levels at Nuttalls Farm were also exceptionally high and registered as the third highest end of July level in record from 1974. Levels in the fast responding Carboniferous Limestone of south Wales were near to above normal.

Centre for Ecology & Hydrology
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Rainfall . . . Rainfall . . .

Rainfall accumulations and return period estimates

Percentages are from the 1971-2000 average.

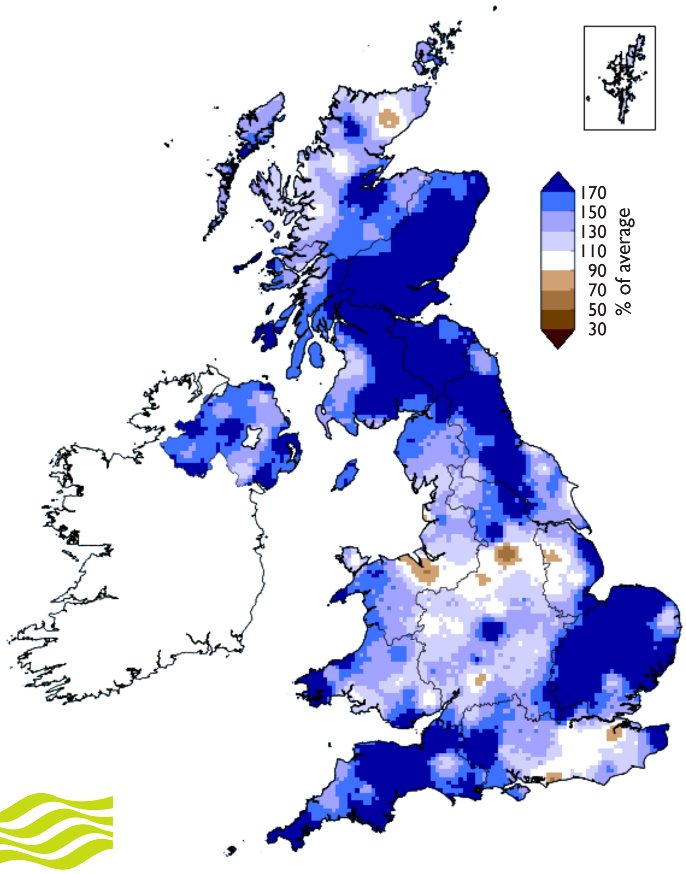
Area	Rainfall	Jul Year	May15 – Jul15	RP	Feb15 – Jul15	RP	Nov14 – Jul15	RP	Aug14 – Jul15	RP
United	mm	**110**	274		495		905		1225	
Kingdom	%	**165**	138	8-12	112	2-5	114	8-12	114	8-12
England	mm	**82**	196		324		594		820	
	%	**158**	116	2-5	93	2-5	99	2-5	101	2-5
Scotland	mm	**152**	393		766		1375		1854	
	%	**177**	165	>100	135	50-80	131	>100	129	>100
Wales	mm	**112**	304		526		1023		1361	
	%	**152**	131	2-5	98	2-5	102	2-5	100	2-5
Northern	mm	**117**	293		526		982		1262	
Ireland	%	**158**	137	5-10	113	5-10	122	30-50	114	10-15
England &	mm	**87**	211		352		653		894	
Wales	%	**157**	119	2-5	94	2-5	100	2-5	101	2-5
North West	mm	**112**	290		529		946		1273	
	%	**144**	130	2-5	111	2-5	112	2-5	109	2-5
Northumbrian	mm	**110**	237		380		635		847	
	%	**191**	134	5-10	104	2-5	104	2-5	103	2-5
Severn-Trent	mm	**62**	180		295		535		733	
	%	**125**	109	2-5	88	2-5	96	2-5	97	2-5
Yorkshire	mm	**85**	217		343		586		798	
	%	**160**	127	2-5	97	2-5	98	2-5	99	2-5
Anglian	mm	**77**	158		241		424		614	
	%	**172**	108	2-5	88	2-5	96	2-5	102	2-5
Thames	mm	**69**	151		252		480		678	
	%	**159**	99	2-5	83	2-5	94	2-5	98	2-5
Southern	mm	**57**	150		258		574		816	
	%	**129**	100	2-5	82	5-10	102	2-5	106	2-5
Wessex	mm	**85**	190		307		598		832	
	%	**181**	117	2-5	86	2-5	94	2-5	97	2-5
South West	mm	**115**	256		440		863		1152	
	%	**187**	126	2-5	92	2-5	97	2-5	96	2-5
Welsh	mm	**108**	293		503		977		1304	
	%	**152**	129	2-5	97	2-5	101	2-5	100	2-5
Highland	mm	**141**	422		906		1635		2260	
	%	**149**	161	90-110	136	20-35	129	40-60	132	>100
North East	mm	**130**	276		451		806		1215	
	%	**196**	142	5-10	112	2-5	117	2-5	129	20-30
Tay	mm	**169**	381		671		1211		1605	
	%	**229**	176	35-45	132	10-20	130	20-30	127	20-35
Forth	mm	**164**	362		632		1057		1361	
	%	**231**	175	40-60	137	30-50	128	25-40	121	15-25
Tweed	mm	**133**	288		496		881		1205	
	%	**206**	148	8-12	122	5-10	126	10-20	127	15-25
Solway	mm	**158**	377		726		1347		1757	
	%	**182**	156	15-25	131	25-40	133	>100	126	60-90
Clyde	mm	**190**	493		967		1738		2209	
	%	**177**	179	>>100	144	>100	139	>100	128	>100

% = percentage of 1971-2000 average *RP = Return period*

Important note: Figures in the above table may be quoted provided their source is acknowledged (see page 12). Where appropriate, specific mention must be made of the uncertainties associated with the return period estimates. The RP estimates are based on data provided by the Met Office and reflect climatic variability since 1910; they also assume a stable climate. The quoted RPs relate to the specific timespans only; for the same timespans, but beginning in any month the RPs would be substantially shorter. The timespans featured do not purport to represent the critical periods for any particular water resource management zone. For hydrological or water resources assessments of drought severity, river flows and/or groundwater levels normally provide a better guide than return periods based on regional rainfall totals. Note that precipitation totals in winter months may be underestimated due to snowfall undercatch. All monthly rainfall totals from January 2015 (inclusive) are provisional.

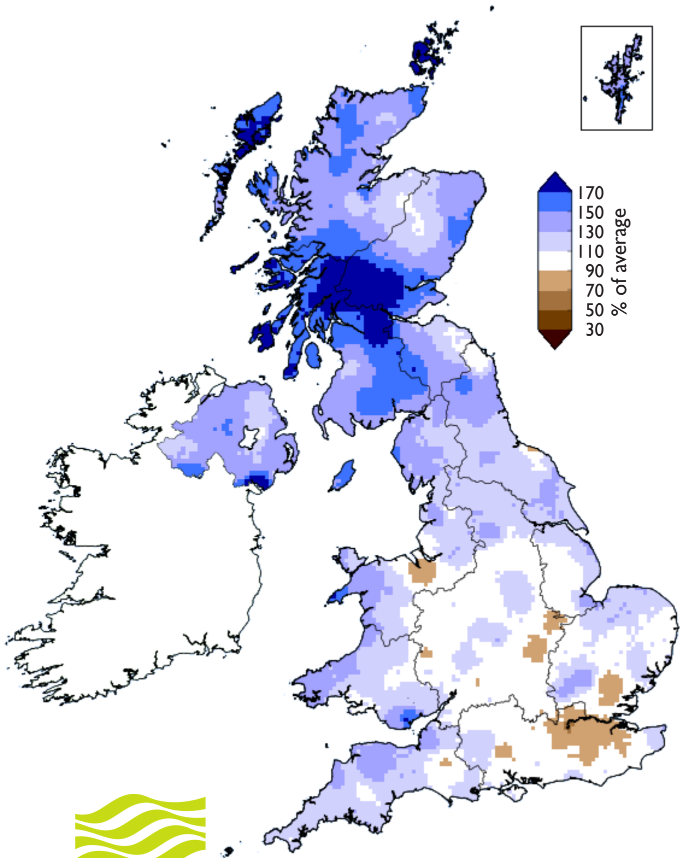
Rainfall . . . Rainfall . . .

July 2015 rainfall as % of 1971-2000 average



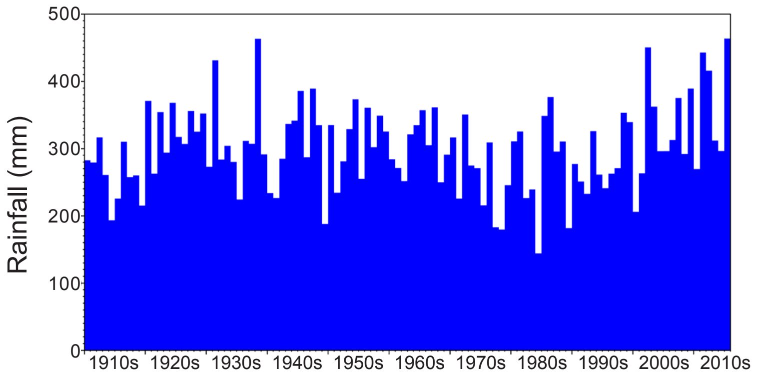
Met Office

May 2015 - July 2015 rainfall as % of 1971-2000 average

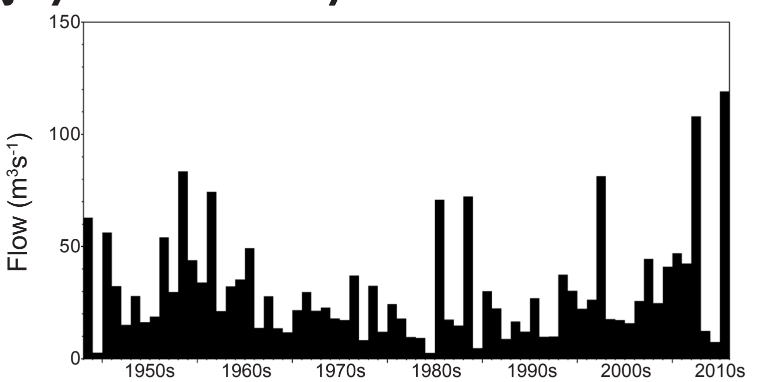


Met Office

July rainfall for Western Scotland



July maximum daily flows for the River Earn



Met Office

Met Office 3-month outlook Updated: July 2015

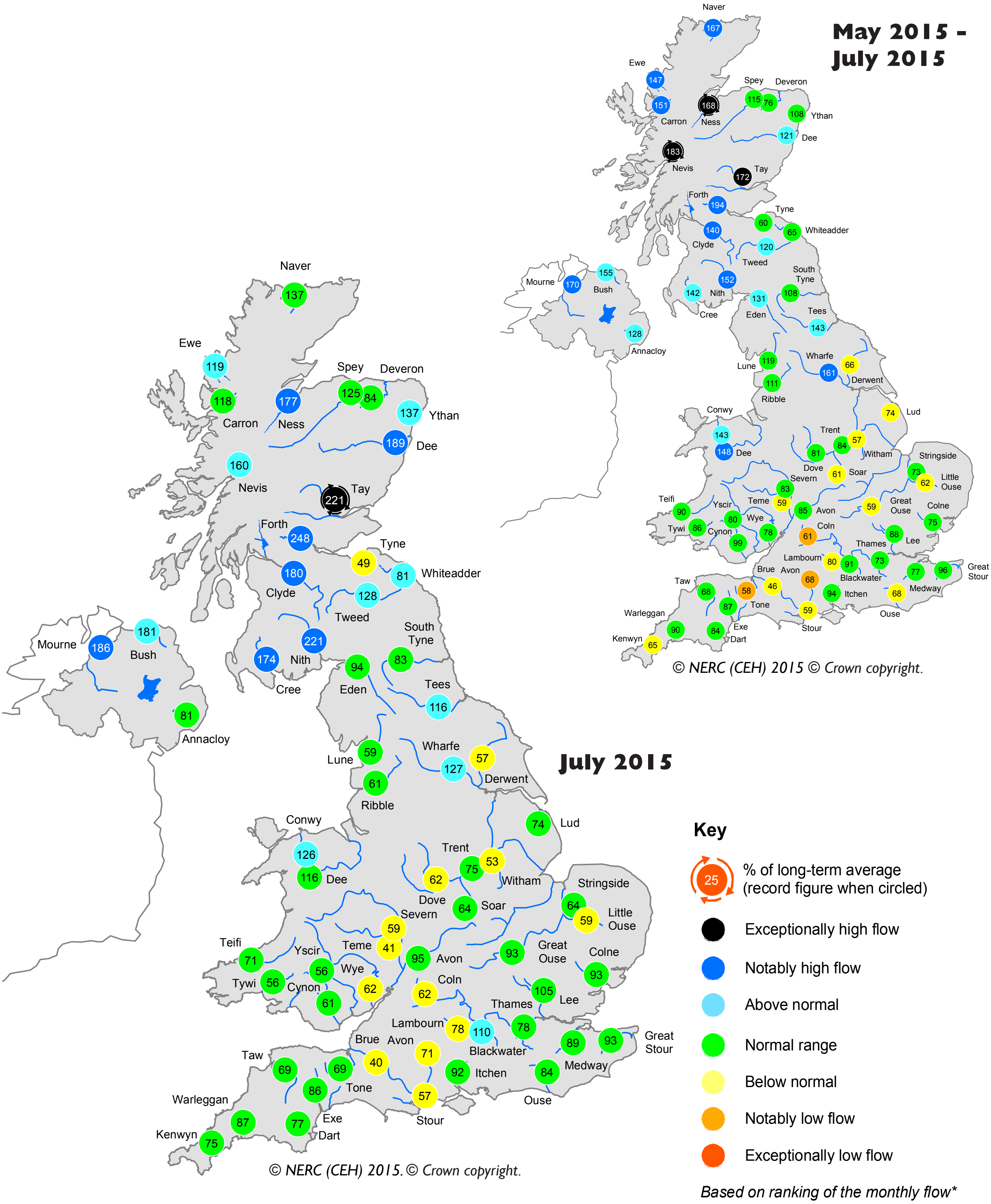
The latest predictions for UK precipitation favour below-average for August-September-October as a whole.

The probability that UK precipitation for August-September-October will fall into the driest of our five categories is around 30% and the probability that it will fall into the wettest of our five categories is 15% (the 1981-2010 probability for each of these categories is 20%).

The complete version of the 3-month outlook may be found at:
http://www.metoffice.gov.uk/publicsector/contingency-planners
This outlook is updated towards the end of each calendar month.

The latest shorter-range forecasts, covering the upcoming 30 days, can be accessed via:
http://www.metoffice.gov.uk/weather/uk/uk_forecast_weather.html
These forecasts are updated very frequently.

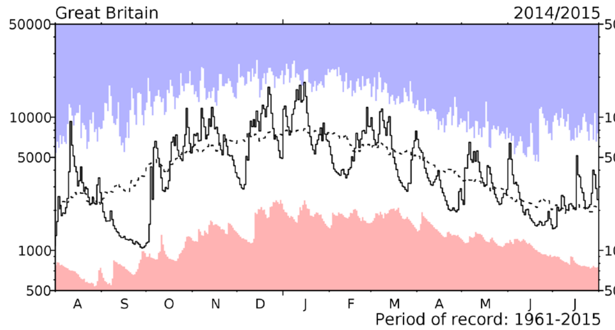
River flow . . . River flow . . .

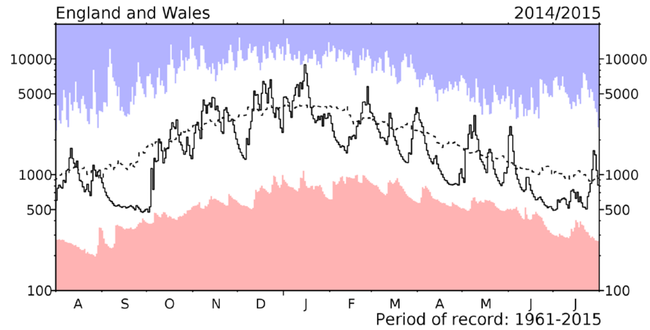


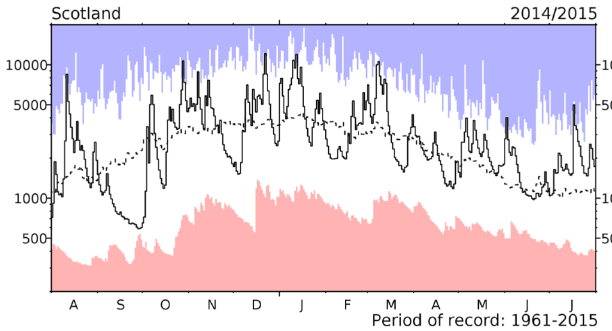
River flows

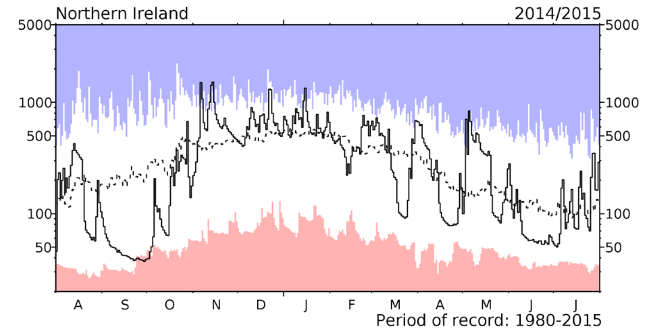
*Comparisons based on percentage flows alone can be misleading. A given percentage flow can represent extreme drought conditions in permeable catchments where flow patterns are relatively stable but be well within the normal range in impermeable catchments where the natural variation in flows is much greater. Note: the period of record on which these percentages are based varies from station to station. Percentages may be omitted where flows are under review.

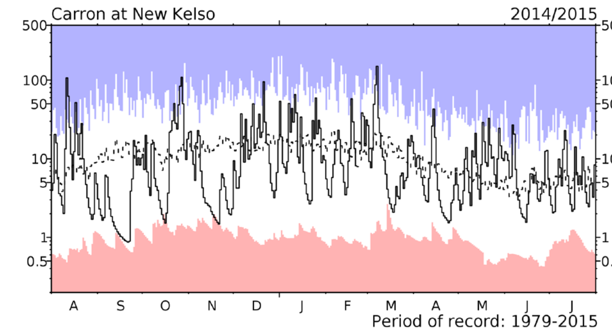
River flow ... River flow ...

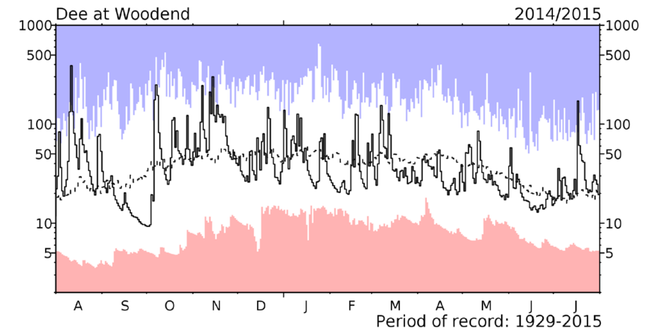


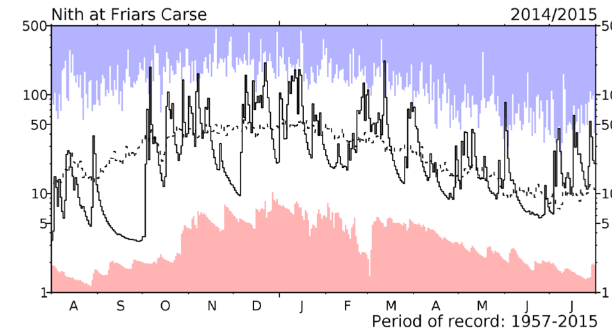


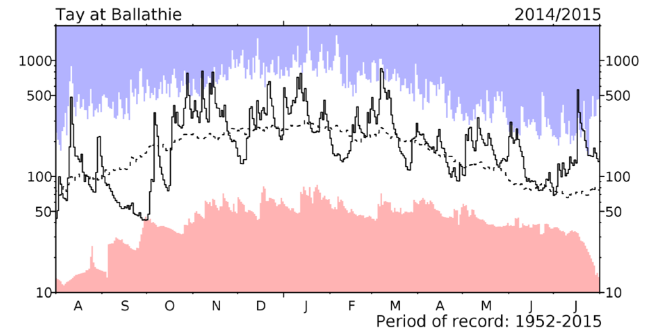


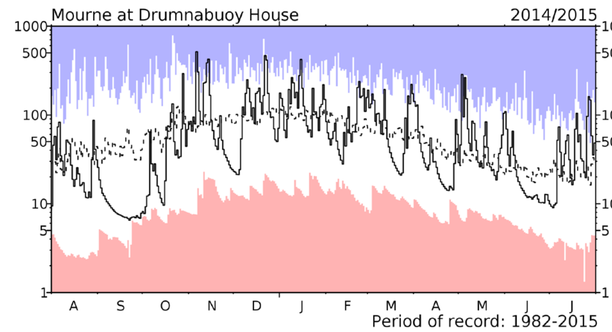


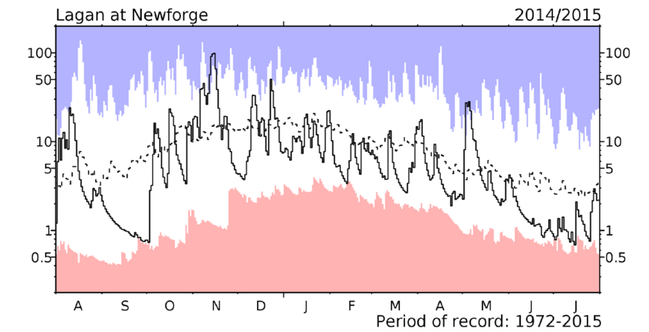








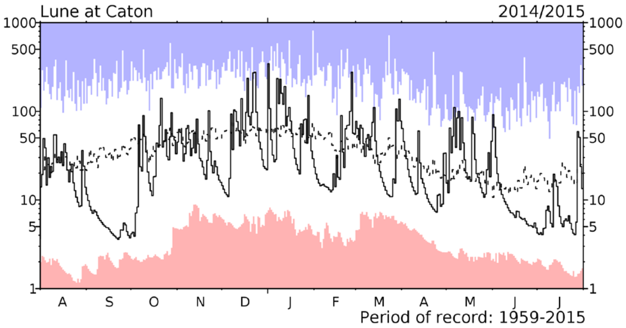


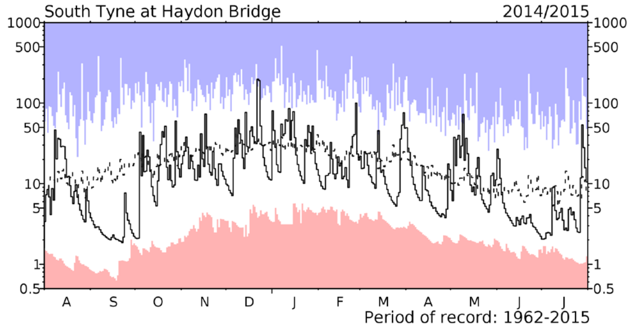


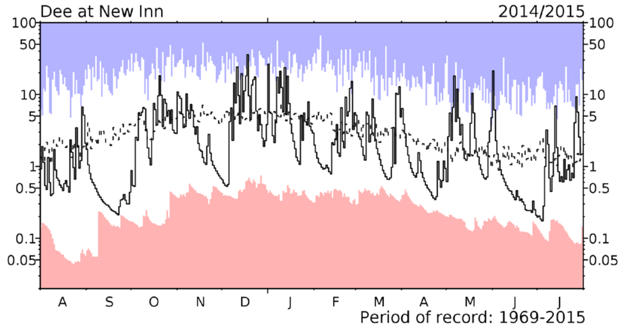
River flow hydrographs

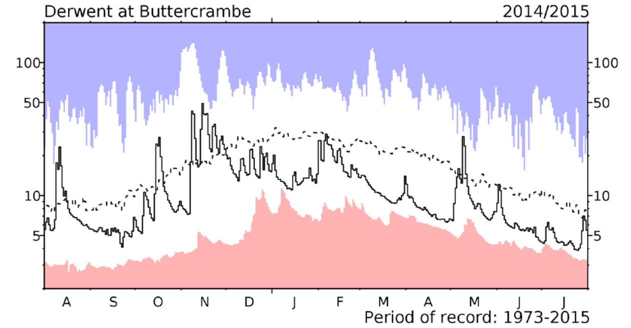
The river flow hydrographs show the daily mean flows together with the maximum and minimum daily flows prior to August 2014 (shown by the shaded areas). Daily flows falling outside the maximum/minimum range are indicated where the bold trace enters the shaded areas. Mean daily flows are shown as the dashed line.

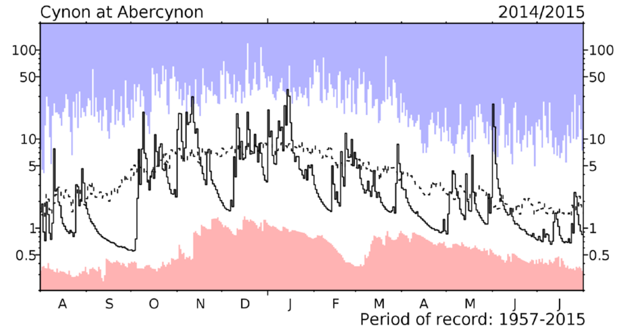
River flow ... River flow ...

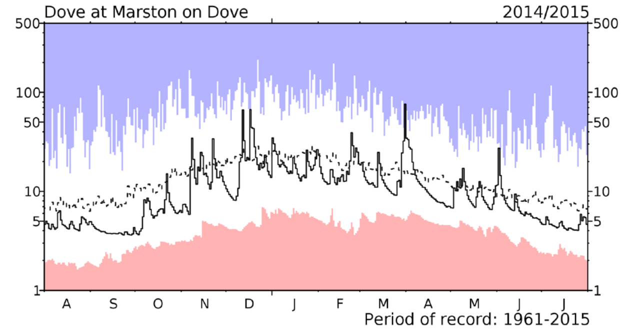


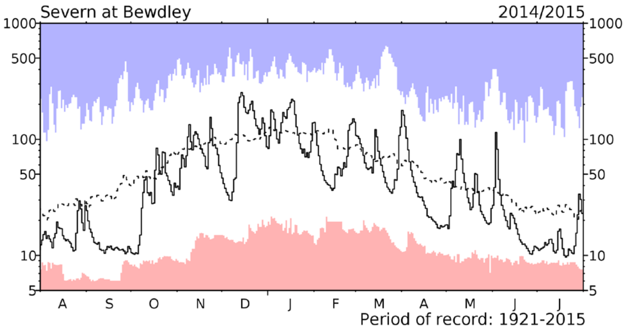


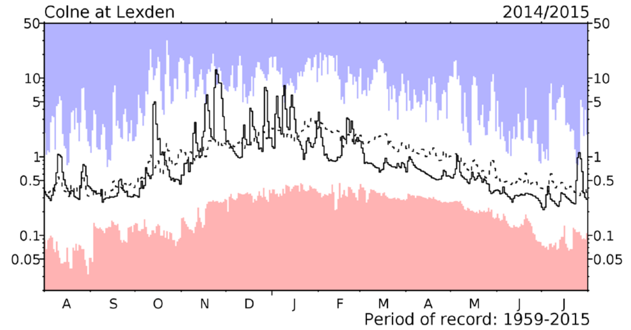


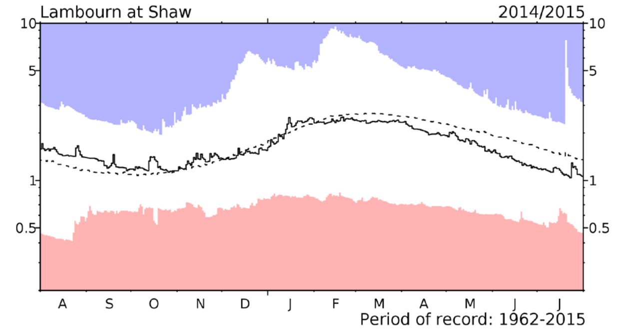


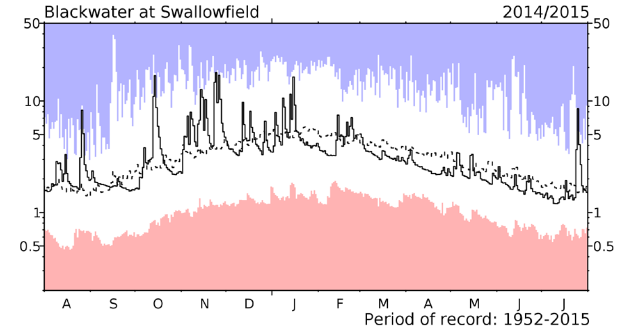


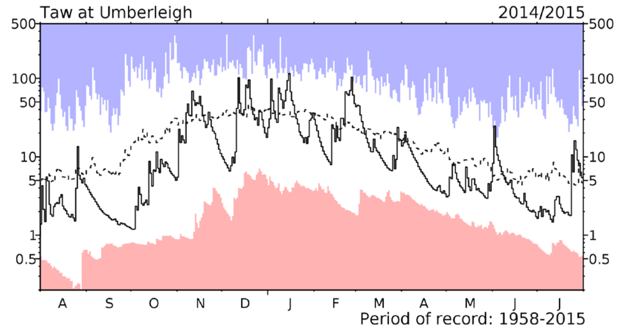


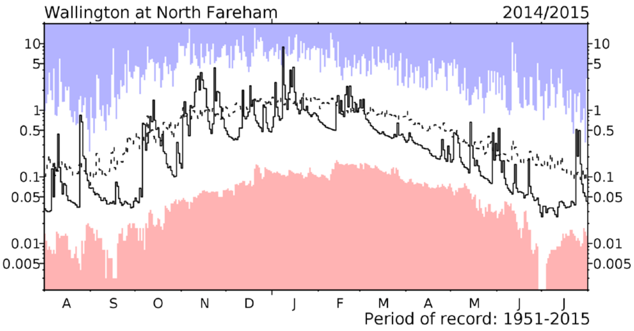


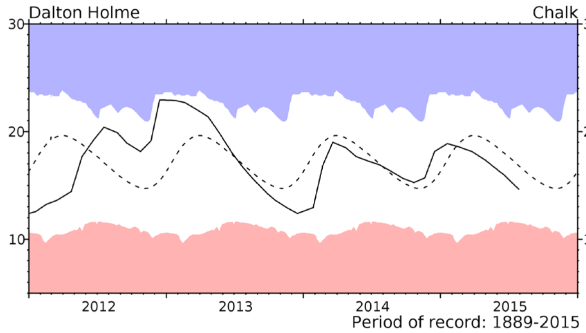


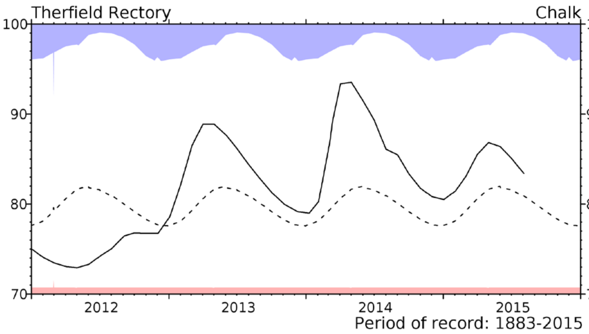


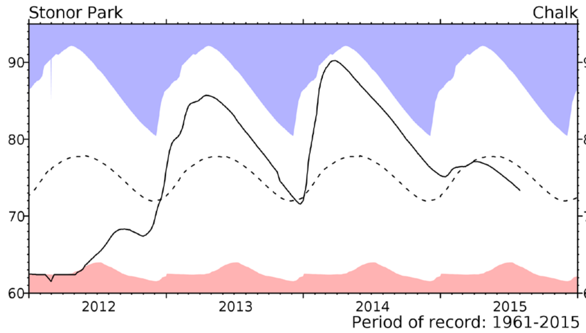


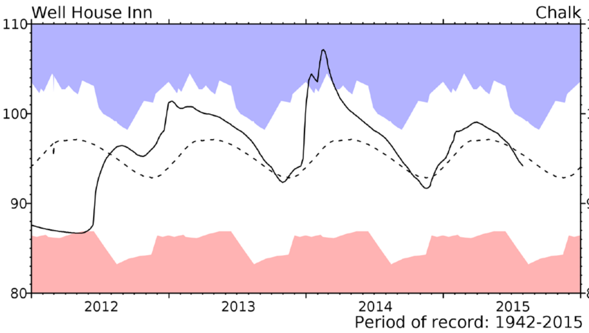


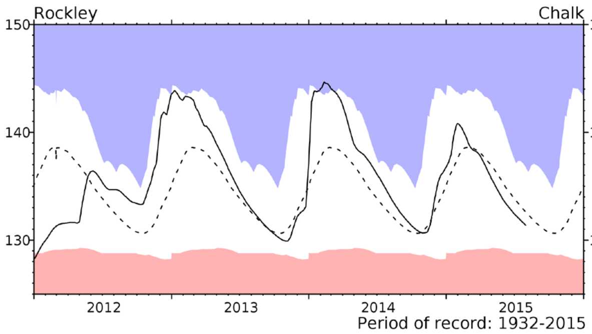


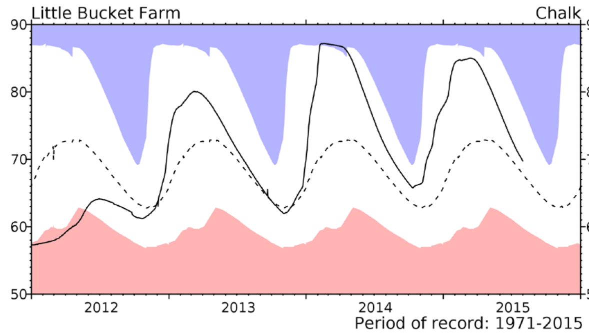


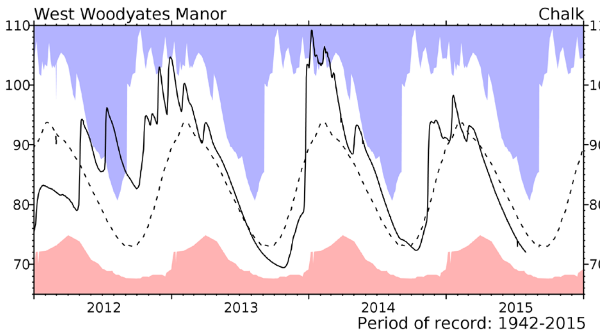


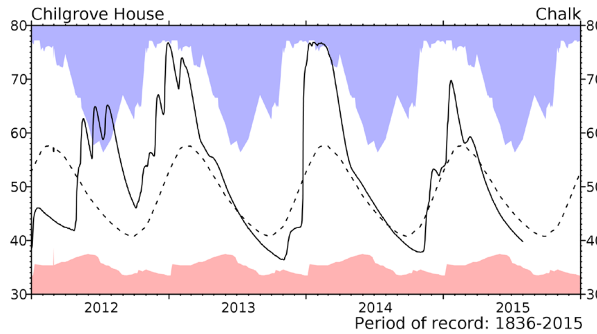


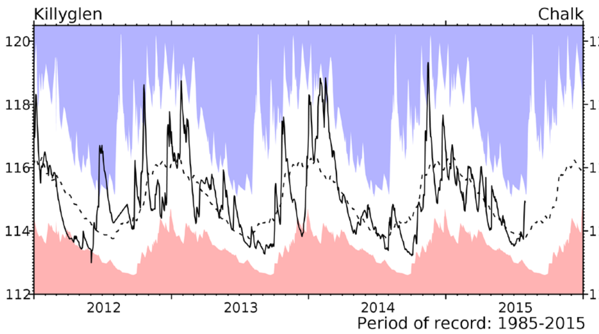


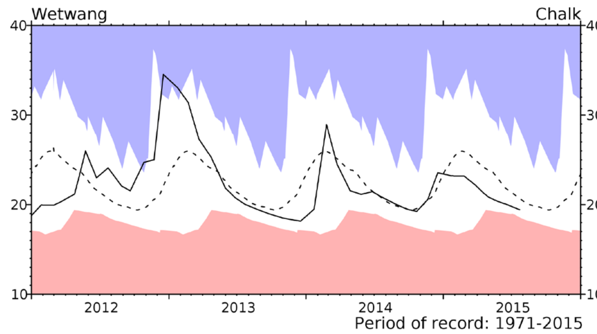






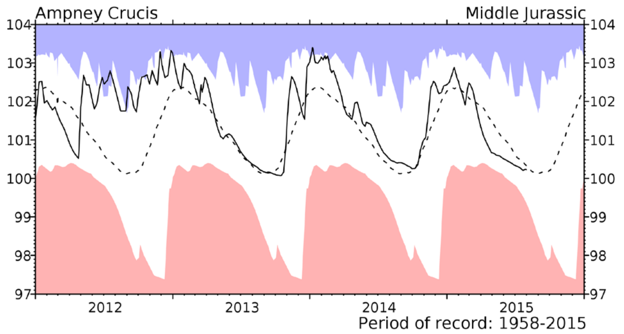


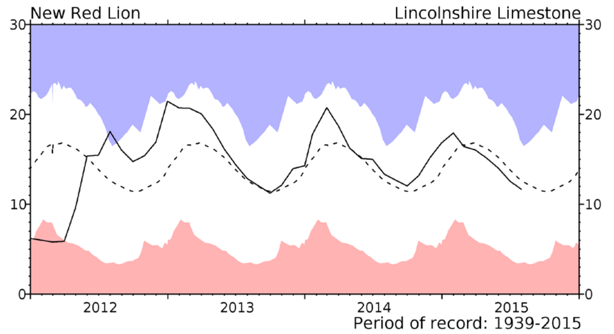


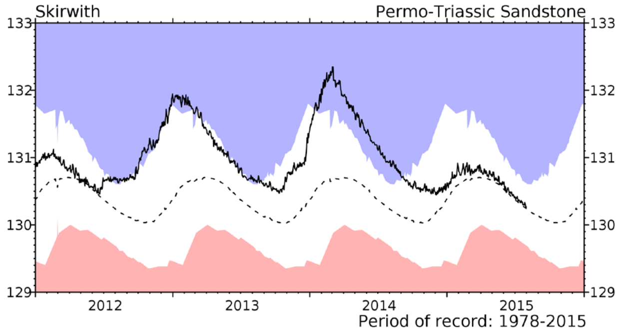


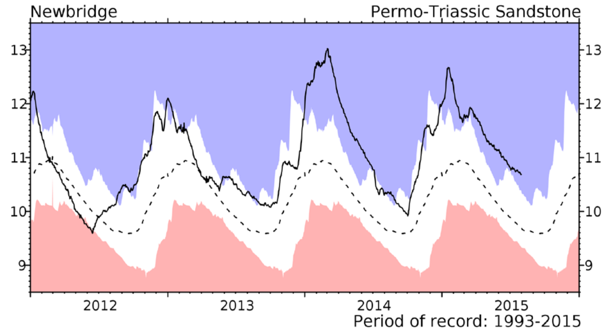
Groundwater levels normally rise and fall with the seasons, reaching a peak in the spring following replenishment through the winter (when evaporation losses are low and soil moist). They decline through the summer and early autumn. This seasonal variation is much reduced when the aquifer is confined below overlying impermeable strata. The monthly mean and the highest and lowest levels recorded for each month are displayed in a similar style to the river flow hydrographs. Note that most groundwater levels are not measured continuously and, for some index wells, the greater frequency of contemporary measurements may, in itself, contribute to an increased range of variation. The latest recorded levels are listed overleaf.

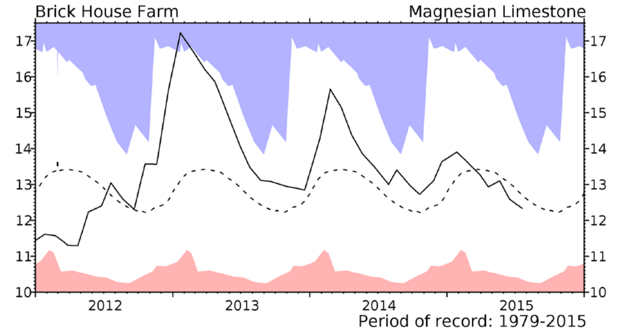
Groundwater ... Groundwater

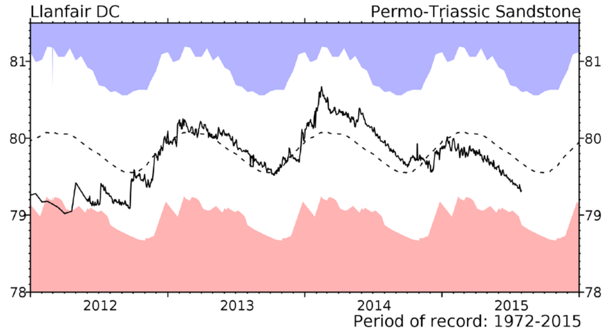


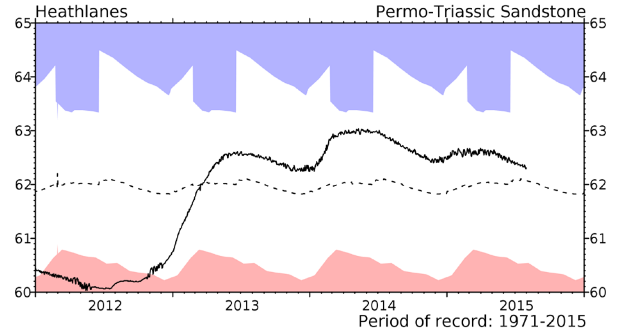


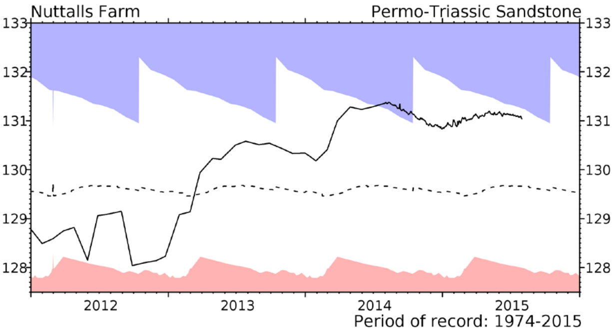


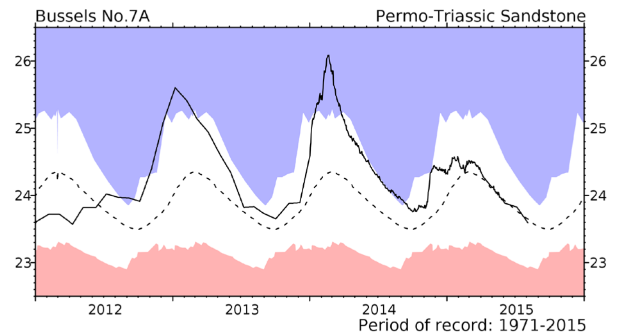


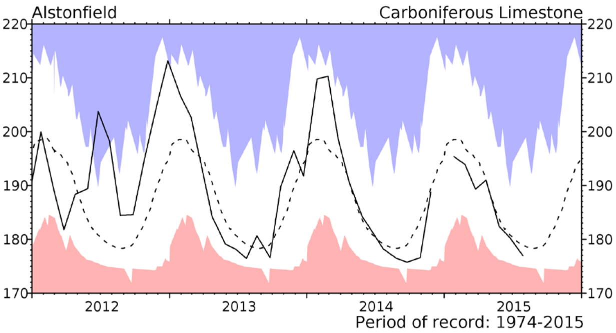










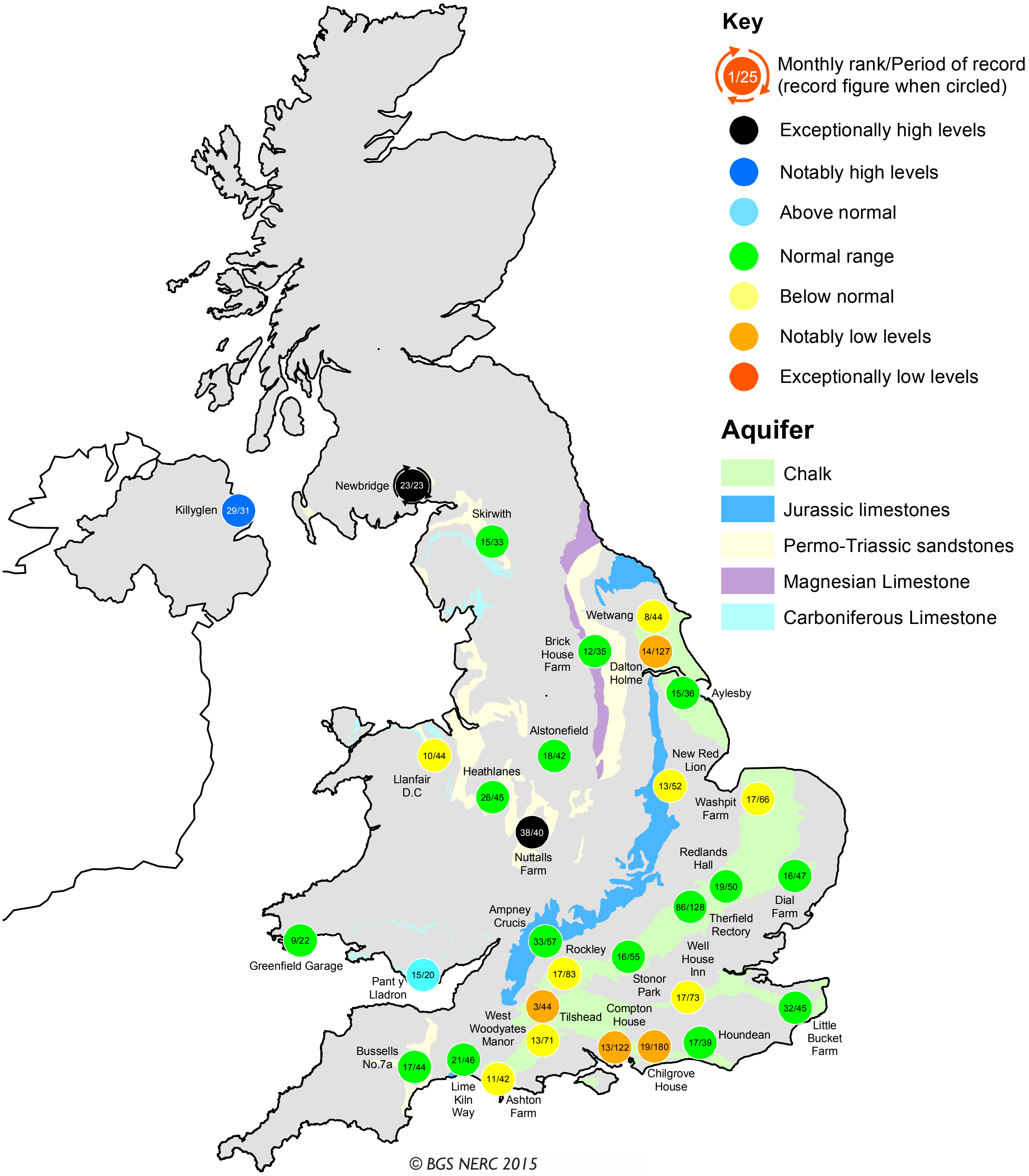


Groundwater levels July / August 2015

Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.	Borehole	Level	Date	Jul av.
Dalton Holme	14.65	28/07	17.22	Chilgrove House	39.72	31/07	43.67	Brick House Farm	12.33	20/07	12.84
Therfield Rectory	83.38	03/08	81.53	Killyglen (NI)	114.91	31/07	113.88	Llanfair DC	79.32	31/07	79.75
Stonor Park	73.33	31/07	77.05	Wetwang	19.41	23/07	20.96	Heathlanes	62.30	31/07	62.07
Tilshead	80.71	31/07	85.03	Ampney Crucis	100.23	31/07	100.50	Nuttalls Farm	131.04	31/07	129.64
Rockley	131.36	31/07	133.24	New Red Lion	11.65	31/07	13.22	Bussells No.7a	23.59	04/08	23.74
Well House Inn	94.18	31/07	95.77	Skirwith	130.29	31/07	130.65	Alstonefield	176.93	29/07	179.81
West Woodyates	72.02	31/07	77.20	Newbridge	10.69	31/07	9.85				

Levels in metres above Ordnance Datum

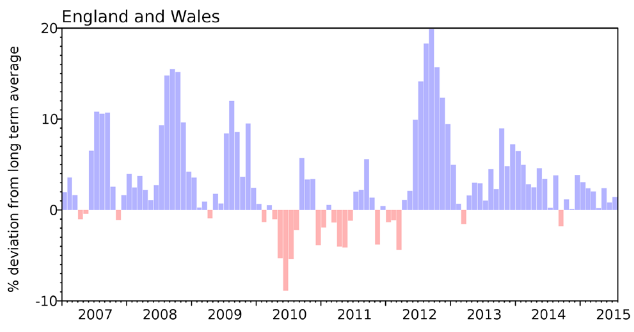
Groundwater...Groundwater



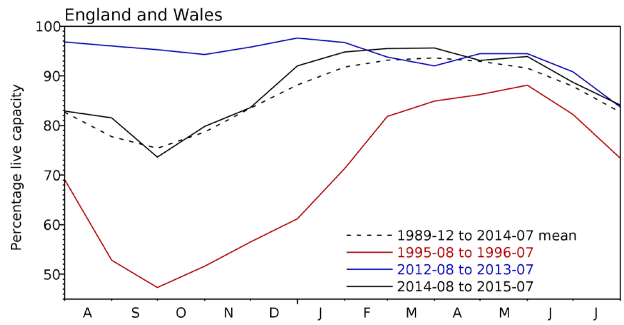
Groundwater levels - July 2015

The calculation of ranking has been modified from that used in summaries published prior to October 2012. It is now based on a comparison between the most recent level and levels for the same date during previous years of record. Where appropriate, levels for earlier years may have been interpolated. The rankings are designed as a qualitative indicator, and ranks at extreme levels, and when levels are changing rapidly, need to be interpreted with caution.

Guide to the variation in overall reservoir stocks for England and Wales



Comparison between overall reservoir stocks for England and Wales in recent years



Percentage live capacity of selected reservoirs at end of month

Area	Reservoir		Capacity (Ml)	2015 May	2015 Jun	2015 Jul	Jul Anom.	Min Jul	Year* of min	2014 Jul	Diff 15-14
North West	N Command Zone	•	124929	90	81	70	6	23	1984	54	16
	Vyrnwy		55146	98	91	86	10	45	1984	75	11
Northumbrian	Teesdale	•	87936	96	83	82	8	45	1989	77	5
	Kielder		(199175)	91	90	95	6	66	1989	88	7
Severn-Trent	Clywedog		44922	100	97	94	9	50	1976	89	5
	Derwent Valley	•	39525	96	90	79	6	43	1996	69	10
Yorkshire	Washburn	•	22035	82	74	69	-5	50	1995	68	1
	Bradford Supply	•	41407	94	85	73	1	38	1995	76	-4
Anglian	Grafham		(55490)	96	95	93	4	66	1997	83	11
	Rutland		(116580)	93	90	87	1	74	1995	91	-4
Thames	London	•	202828	92	86	80	-7	73	1990	94	-14
	Farmoor	•	13822	95	95	99	3	84	1990	97	2
Southern	Bewl		28170	89	84	74	-3	45	1990	86	-12
	Ardingly		4685	100	89	72	-14	65	2005	84	-12
Wessex	Clatworthy		5364	82	76	67	-7	43	1992	73	-6
	Bristol	•	(38666)	90	81	72	-4	53	1990	84	-12
South West	Colliford		28540	88	85	78	0	47	1997	86	-9
	Roadford		34500	90	87	79	2	46	1996	87	-8
	Wimbleball		21320	92	87	76	-2	53	1992	88	-12
	Stithians		4967	95	76	66	-5	39	1990	75	-9
Welsh	Celyn & Brenig	•	131155	100	99	92	3	65	1989	86	6
	Brianne		62140	100	97	97	7	67	1995	88	9
	Big Five	•	69762	92	87	77	-1	41	1989	84	-7
	Elan Valley	•	99106	99	91	86	4	53	1976	83	3
Scotland(E)	Edinburgh/Mid-Lothian	•	97639	95	89	88	5	51	1998	86	2
	East Lothian	•	10206	100	98	93	4	72	1992	98	-5
Scotland(W)	Loch Katrine	•	111363	92	85	94	20	53	2000	73	21
	Daer		22412	97	88	97	16	56	2013	76	21
	Loch Thom	•	11840	100	100	100	16	59	2000	90	10
Northern Ireland	Total+	•	56800	93	86	86	8	54	1995	73	13
	Silent Valley	•	20634	95	86	87	13	42	2000	69	18

( ) figures in parentheses relate to gross storage • denotes reservoir groups *last occurrence

+ excludes Lough Neagh

Details of the individual reservoirs in each of the groupings listed above are available on request. The percentages given in the Average and Minimum storage columns relate to the 1988-2012 period except for West of Scotland and Northern Ireland where data commence in the mid-1990s. In some gravity-fed reservoirs (e.g. Clywedog) stocks are kept below capacity during the winter to provide scope for flood attenuation purposes. Monthly figures may be artificially low due to routine maintenance or turbidity effects in feeder rivers.

Location map…Location map

NHMP

The National Hydrological Monitoring Programme (NHMP) was started in 1988 and is undertaken jointly by the Centre for Ecology & Hydrology (CEH) and the British Geological Survey (BGS). The NHMP aims to provide an authoritative voice on hydrological conditions throughout the UK, to place them in a historical context and, over time, identify and interpret any emerging hydrological trends. Hydrological analysis and interpretation within the Programme is based on the data holdings of the National River Flow Archive (NRFA; maintained by CEH) and National Groundwater Level Archive (NGLA; maintained by BGS), including rainfall, river flows, borehole levels, and reservoir stocks.

Data Sources

The NHMP depends on the active cooperation of many data suppliers. This cooperation is gratefully acknowledged. River flow and groundwater level data are provided by the Environment Agency (EA), Natural Resources Wales - Cyfoeth Naturiol Cymru (NRW), the Scottish Environment Protection Agency (SEPA) and, for Northern Ireland, the Rivers Agency and the Northern Ireland Environment Agency. In all cases the data are subject to revision following validation (high flow and low flow data in particular may be subject to significant revision).

Details of reservoir stocks are provided by the Water Service Companies, the EA, Scottish Water and Northern Ireland Water.

The Hydrological Summary and other NHMP outputs may also refer to and/or map soil moisture data for the UK. These data are provided by the Meteorological Office Rainfall and Evaporation Calculation System (MORECS). MORECS provides estimates of monthly soil moisture deficit in the form of averages over 40 x 40 km grid squares over Great Britain and Northern Ireland. The monthly time series of data extends back to 1961.

Rainfall data are provided by the Met Office. To allow better spatial differentiation the rainfall data for Britain are presented for the regional divisions of the precursor organisations of the EA, NRW and SEPA. The areal rainfall figures have been produced by the Met Office National Climate Information Centre (NCIC), and are based on 5km resolution gridded data from rain gauges. The majority of the full rain gauge network across the UK is operated by the EA, NRW, SEPA and Northern Ireland Water; supplementary rain gauges are operated by the Met Office. The Met Office NCIC monthly rainfall series extend back to 1910 and form the official source of UK areal rainfall statistics which have been adopted by the NHMP. The gridding technique used is described in Perry MC and Hollis DM (2005) available at http://www.metoffice.gov.uk/climate/uk/about/methods

Long-term averages are based on the period 1971-2000 and are derived from the monthly areal series.

The regional figures for the current month in the hydrological summaries are based on a limited rain gauge network so these (and the associated return periods) should be regarded as a guide only.

The monthly rainfall figures are provided by the Met Office NCIC and are Crown Copyright and may not be passed on to, or published by, any unauthorised person or organisation.

For further details on rainfall or MORECS data, please contact the Met Office:

Tel: 0870 900 0100
Email: enquiries@metoffice.gov.uk

Enquiries

Enquiries should be directed to the NHMP:

Tel: 01491 692599
Email: nhmp@ceh.ac.uk

A full catalogue of past Hydrological Summaries can be accessed and downloaded at:

http://www.ceh.ac.uk/data/nrfa/nhmp/nhmp.html

08/2015

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